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The Impact of the Problem-Based Learning Model with an Open-Ended Approach on the Creative Thinking Skills of 10th Grade Students in Quadratic Function Education

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Abstract
This study aims to evaluate the effect of integrating the Problem-Based Learning (PBL) model with an open-ended approach on the creative thinking skills of 10th-grade students in mathematics, specifically in the topic of Quadratic Functions. The research was conducted at Cahaya Medan Private High School, involving six 10th-grade classes. Two classes were selected as the sample: Class X-2, which participated in the experimental group and received instruction through the PBL model with an open-ended approach, and Class X-3, the control group, which followed traditional teaching methods. Each group consisted of 34 students. A quasi-experimental design was employed, incorporating pretest and posttest evaluations, along with five validated open-ended questions to assess the outcomes. Data analysis was performed using a t-test. The experimental group achieved an average posttest score of 84.94, while the control group scored 77.09. The t-test results showed that the PBL model, when combined with the open-ended approach, significantly improved the students' creative thinking abilities in learning Quadratic Functions.
Keywords: Open-Ended Approach, Creative Thinking, Quadratic Functions

Abstrak
Penelitian ini bertujuan untuk mengevaluasi pengaruh pengintegrasian model Problem-Based Learning (PBL) dengan pendekatan open-ended terhadap keterampilan berpikir kreatif siswa kelas 10 dalam matematika, khususnya pada topik Fungsi Kuadrat. Penelitian ini dilakukan di SMA Swasta Cahaya Medan, melibatkan enam kelas 10. Dua kelas dipilih sebagai sampel: Kelas X-2, yang berpartisipasi dalam kelompok eksperimen dan menerima instruksi melalui model PBL dengan pendekatan open-ended, dan Kelas X-3, kelompok kontrol, yang mengikuti metode pengajaran tradisional. Setiap kelompok terdiri dari 34 siswa. Desain quasi-eksperimental digunakan, menggabungkan evaluasi pretest dan posttest, bersama dengan lima pertanyaan open-ended yang divalidasi untuk menilai hasil. Analisis data dilakukan dengan menggunakan uji-t. Kelompok eksperimen mencapai skor posttest rata-rata 84,94, sedangkan kelompok kontrol mendapat skor 77,09. Hasil uji-t menunjukkan bahwa model PBL jika dipadukan dengan pendekatan terbuka mampu meningkatkan kemampuan berpikir kreatif siswa dalam pembelajaran Fungsi Kuadrat secara signifikan.
Kata Kunci: PBL, Pendekatan Open-Ended, Berpikir Kreatif, Fungsi Kuadrat

INTRODUCTION

Significant advancements in science and technology have been introduced in the 21st century, impacting various aspects of human life. The emergence of the Fourth Industrial Revolution has been marked as a major outcome of these developments. To maintain competitiveness in this rapidly evolving landscape, the cultivation of a highly skilled and knowledgeable workforce is considered essential. The development of individuals with exceptional abilities is facilitated by the education system (Mahrunnisya, 2023). In Indonesia, the emphasis has been placed on fostering essential 21st-century competencies, including creativity, critical thinking, problem-solving, communication, and collaboration, collectively referred to as the 4Cs (Zakaria, 2021; Mardhiyah et al., 2021). The development of creative thinking skills is recommended to begin at an early stage, particularly in mathematics education, through the application of innovative and nontraditional methods (Sya'Roni et al., 2020; Zakaria, 2021; Rasnawati et al., 2019). The evaluation of these skills is considered crucial for identifying students' potential and ensuring the continuous enhancement of their abilities (Sulistiyarini et al., 2020). The importance of creative thinking in preparing students to generate innovative solutions for more complex challenges in the future has been highlighted by Kartikasari et al. (2022).

Creative thinking in mathematics is recognized as essential for adapting to rapid advancements in science and technology, as well as addressing increasing global challenges and competition (Santi et al., 2019). The cultivation of creativity in students has been emphasized as a critical component of mathematics education. Learning experiences that inspire independent exploration and the development of solutions based on individual abilities are encouraged in mathematics instruction. It has been noted by Kadir et al. (2022) that mathematics education should prioritize not only content mastery but also the enhancement of mathematical thinking skills, such as creativity, critical thinking, and logical reasoning. The initiation of creative thinking development is ideally recommended at the elementary level. Students demonstrating creativity in mathematics are seen as more capable of applying their innovative thinking to various fields and effectively addressing global issues. The generation of new ideas and the discovery of novel problem-solving strategies are considered integral aspects of creative thinking in mathematics (Saidah et al., 2020; Kadir et al., 2022). The development of creative thinking skills in mathematics is dependent on intentional practice and guided instruction. The fostering of these skills is significantly influenced by educators through the design of lessons centered on practical, real-world problems. Opportunities for enhancing creative thinking, logical reasoning, problem-solving abilities, communication skills, and the application of mathematical concepts in real-world contexts are provided by mathematics education. Additionally, the effective integration of technology is emphasized as a crucial component of this learning process.

Research has indicated that students' creative thinking skills in mathematics remain underdeveloped. Key findings include the following: (1) Low levels of creative thinking in mathematics were identified among 8th-grade students at SMP Negeri 1 Merbau, as shown by an average score of 50.27% (Sari Hrp, 2022); (2) Weak creative thinking skills in sequences and series were observed among 11th-grade students at SMA Negeri 1 Enok, with an average score of only 29% (Wardani & Suripah, 2023); and (3) Minimal improvement in creative thinking skills, with an increase of just 12.92%, was reported among students taught using traditional methods (Purba & Harahap, 2021). The development of students' creative thinking abilities in mathematics is hindered by several factors, including limited active participation in problem-solving tasks. Improvements to the learning process are required through the implementation of more dynamic and innovative teaching strategies. The reliance on repetitive methods has been identified as a contributing factor to student passivity, where learners focus on replicating solutions provided by teachers rather than developing a deeper understanding of mathematical concepts. As a result, the potential for creative thinking among students remains largely underutilized (Utami et al., 2020).

The presentation of problems designed to encourage independent solution-finding is recognized as an effective method for enhancing students' creative thinking skills in mathematics. Engaging with such challenges prepares students to address future difficulties more effectively. The creation of a supportive learning environment that fosters a sense of security and motivates active participation is deemed essential for the development of students' creative thinking abilities (Fajarwati & Ninawati, 2023). Field study interviews indicate that students at SMA Cahaya Medan face challenges in developing creative thinking skills in mathematics. Classroom observations revealed that passivity among students is prevalent, as they struggle with answering analytical questions, rarely offer new ideas, and find it difficult to expand their thinking. Most students rely solely on the methods taught to them, without extending or deepening their responses. Additionally, the use of ineffective teaching strategies, where teachers focus exclusively on logical reasoning with predetermined answers, has been identified as a barrier. These findings align with the conclusions of Primadoni and Muslim (2023), who noted that the lack of creative thinking in students is linked to teaching methods that do not foster creativity. The current teaching approaches have not been effective in motivating students to explore additional resources that could encourage innovative thinking.

Mathematics is often perceived as a difficult subject by students, particularly due to their tendency to rely solely on the solutions provided by teachers, especially in topics such as Quadratic Functions, which are part of the 2013 curriculum for 10th-grade students. This topic encompasses the characteristics of quadratic equations, discriminants, lines of symmetry, and the graph of quadratic functions (Azmi & Yunita, 2022). The perception of mathematics as challenging often leads to fear and anxiety among students. Contributing factors to these struggles include teaching methods that fail to actively engage students. When students are not provided with opportunities for hands-on participation, passivity sets in, limiting their understanding. Badariyah (2019) emphasizes that the lack of student involvement in learning activities is a primary factor in the challenges they encounter in learning mathematics. Innovative teaching methods, such as Problem-Based Learning (PBL), have been identified as effective solutions to address these challenges. This approach aims to enhance both the learning experience and its outcomes by initiating lessons with real-world problems and encouraging students to develop their own solutions (Arends, 2013). Active participation is promoted through PBL, making learning more engaging and meaningful. In this model, the teacher assumes the roles of motivator, facilitator, and guide, providing support to students throughout the problem-solving process (Mussafah & Aprinastuti, 2023). Research has demonstrated that PBL significantly enhances students' creative thinking, particularly in topics such as quadratic functions (Pamungkas & Sudigdo, 2022; Satria et al., 2022). Additionally, this approach has been shown to substantially improve students' mathematical problem-solving skills (Sholikah et al., 2023).

Open-ended mathematics problems are designed to stimulate creative problem-solving by offering multiple solutions and encouraging the exploration of various strategies (Jayanti & Julianingsih, 2021). By engaging with these problems, students are given the opportunity to apply a range of methods, including those they may not have considered before (Wijayanti et al., 2019). These problems are particularly beneficial in teaching Quadratic Functions due to their complexity and relevance to real-world situations. They present challenges with multiple solution paths, allowing students to explore different approaches (Suryaningsih & Astuti, 2021). The objective is to foster active participation in creative tasks and enhance mathematical reasoning through problem-solving. This approach aligns with the perspective of Hartini et al. (2014), who highlight the benefits of combining Problem-Based Learning (PBL) with open-ended questions in mathematics instruction to increase student involvement and focus. In this model, students can work either individually or in groups, employing appropriate strategies to solve the problems. Open-ended questions offer several correct answers or methods, creating challenges that promote cognitive development. The aim of this study is to investigate the impact of implementing a Problem-Based Learning (PBL) model combined with open-ended questions on the creative thinking skills of 10th-grade students at SMA Cahaya Medan.

RESERCH METHOD

The research was conducted during the second semester of the 2023/2024 academic year, involving 10th-grade students from six different classes. A quasi-experimental design with a quantitative approach was employed for the study. Two classes were selected as participants through simple random sampling: one class, consisting of 34 students, was assigned to the experimental group, while the other class was designated as the control group. Both groups underwent pretest and posttest evaluations. The experimental group received instruction using the Problem-Based Learning model combined with an open-ended question approach, whereas the control group was taught using traditional methods. A two-group pretest-posttest control design was applied in this study, as illustrated in Table 1.

Table 1. Pretest-Posttest Design with Two Groups

Class	Pretest	Treatment	Postest
Experiment	X_1	Y_1	X_2
Control	X_1	Y_2	X_2

Description:
X1: Pretest
Y1: Problem-Based Learning (PBL) combined with an open-ended question approach
Y2: Conventional teaching methods
X2: Posttest

Data collection involved the administration of written assessments to evaluate students' abilities before and after mathematics instruction. These assessments, which focused on Quadratic Functions, included five validated questions designed to assess the key indicators of creative thinking: fluency, flexibility, originality, and elaboration (Torrance, 1990). The data were analyzed using both descriptive and inferential statistical methods with IBM SPSS Statistics 29 for Windows. Descriptive analysis was conducted to evaluate students' performance throughout the learning process, while inferential analysis, including a t-test, was performed after confirming the assumptions of data normality and homogeneity.

RESEARCH RESULT AND DISSCUSSION

The research was conducted at Cahaya Medan Senior High School, involving two classes. Class X-2 was assigned as the experimental group, while Class X-3 functioned as the control group, with each class comprising 34 students. The experimental group received instruction using an open-ended question approach, supplemented by student worksheets (LKPD), whereas the control group was taught using traditional methods. Prior to the intervention, a pretest was administered to evaluate the students' baseline creative thinking abilities, unaffected by the open-ended question approach. The pretest results indicated that the experimental group scored an average of 26.82, while the control group had an average score of 27.74. A detailed summary of the pretest results for both groups is provided in Table 2, with Figure 1 visually illustrating these outcomes.

Table 2. Pretest Scores of the Experimental Class and Posttest

	Statistic	Experiment Class	Control Class
1	N	34	34

2	Total value	912	943
3	Average	26,8	27,74
4	Standard deviation	8,383	9,799
5	Varians	70,271	96,019
6	Maximum	45	9
7	Minimum	13	43

Table 2 presents the pretest results, showing that the experimental group achieved an average score of 26.82, with a maximum score of 45, a minimum score of 13, and a standard deviation of 8.383. In contrast, the control group had an average pretest score of 27.74, with a highest score of 43, a lowest score of 9, and a standard deviation of 9.799. The relatively low average pretest scores in both groups underscore the necessity for further exploration to address the gaps in students' creative thinking skills in mathematics.

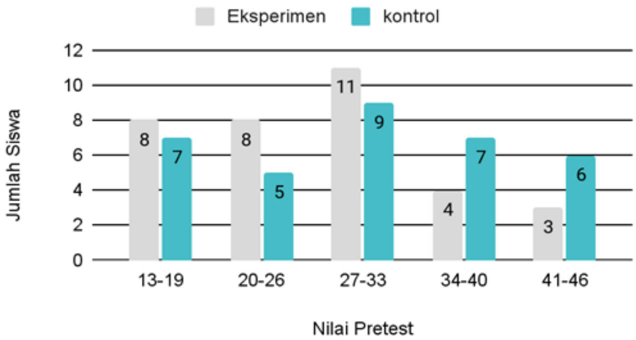

Figure 1. Comparison of Pretest Scores between the Experimental and Control Classes

Figure 1 compares the pretest results between the experimental and control groups across various score ranges. In the lower score intervals (13–19 and 20–26), a greater number of students were found in the control group, indicating relatively weaker initial creative thinking abilities in mathematics prior to the instructional intervention. Conversely, a larger proportion of students in the experimental group scored within the higher intervals (34–40 and 41–46), suggesting that some students in this group possessed stronger baseline potential for mathematical creative thinking before the learning activities. The students' initial abilities were assessed prior to the commencement of the learning sessions, where each class was exposed to different teaching methods. The experimental group (X-2) received instruction through the Problem-Based Learning (PBL) model combined with an open-ended question approach, while the control group (X-3) was taught using traditional methods. Following the learning sessions, both groups participated in a posttest to assess the development of their creative thinking skills based on the applied teaching methods. A summary of the posttest results is provided in Table 3, with the outcomes also illustrated in Figure 2.

Table 3. Posttest Score Results for the Experimental and Control Groups

	Statistic	Experiment Class	Control Class
1	N	34	34
2	Total value	2888	2621
3	Average	84,94	77,09
4	Standard deviation	10,174	11,489
5	Varians	103,512	131,901
6	Maximum	100	95
7	Minimum	35	60

Table 3 presents the difference in average creative thinking skills between the experimental and control groups. The experimental group, which received instruction using the open-ended question approach, achieved an average score of 84.94, notably higher than the control group's average score of 77.09, which was obtained through traditional teaching methods. These findings support the research conducted by Situmorang (2022), which emphasizes the significant impact of the open-ended question approach in enhancing students' creative thinking abilities. This teaching method has been shown to effectively foster the development of innovative ideas, expand cognitive skills, and improve students' problem-solving abilities across various challenges.

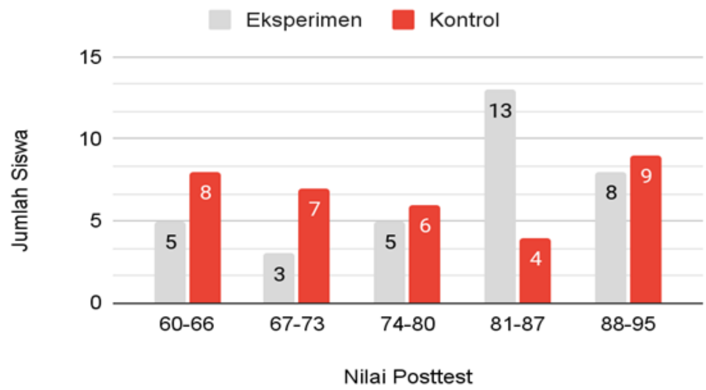

Figure 2. Comparison of Posttest Scores Between the Experimental and Control Classes

Figure 2 compares the posttest results between the experimental class (X-2) and the control class (X-3), which utilized different teaching methods. The data indicate a significant improvement in the mathematical creative thinking skills of students in the experimental group compared to those in the control group. The application of the Problem-Based Learning (PBL) model combined with open-ended questions offered students more opportunities to approach problems creatively, thereby encouraging the generation of original ideas and solutions. This is evident in the higher percentage of students in the experimental group who achieved top scores (86–100) following the learning intervention. In contrast, students in the control group, who were taught using traditional methods, primarily obtained scores within the middle to lower ranges (65–71 and 72–78). The rigid nature of conventional teaching methods was found to be less effective in promoting creative thinking. Consequently, the disparity in teaching methods had a significant effect on the posttest results, with the open-ended Problem-Based Learning (PBL) approach demonstrating greater effectiveness in enhancing students' creative thinking skills. The test results from the experimental and control groups were analyzed using a t-test, with the assumption that the data were normally distributed and homogeneous. To confirm this assumption, a normality test was conducted to determine whether the residuals in the regression model followed a normal distribution. The Kolmogorov-Smirnov test was employed for this analysis using SPSS version 29. The criteria for interpreting the normality test results are as follows:

1. A significance value greater than 0.05 indicates that the data follow a normal distribution.
2. A significance value less than 0.05 suggests that the data do not follow a normal distribution.

The results of the normality test presented in Table 4 show a Kolmogorov-Smirnov significance value of 0.209 and a Shapiro-Wilk significance value of 0.450. Since both values are greater than 0.05, it can be concluded that the post-test data for both groups follow a normal distribution.

Table 4. Results of the Normality Test

1	2	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistik	df	Sig.	Statistik	df	Sig.
	Eksperimen	0,159	34	0,209	0,936	34	0,450
	Kontrol	0,107	34	0,200	0,928	34	0,280

A homogeneity test was conducted to evaluate the reliability of the statistical analysis and ensure the accuracy of the conclusions. The interpretation criteria for the test results are as follows:

1. A significance value (Sig.) below 0.05 indicates unequal variances between the data groups, suggesting non-homogeneity.
2. A significance value (Sig.) above 0.05 indicates equal variances between the data groups, confirming homogeneity. The results of the homogeneity test, presented in Table 5, show significance values of 0.185 for the mean and 0.177 for the median, both exceeding the 0.05 threshold. These findings confirm that the variance of the post-test data for both groups is homogeneous.

Table 5. Results of the Homogeneity Test

		Levene Statistic	df1	df2	Sig.
1	Based on Mean	1.794	1	66	0,185
	Based on Median	1.860	1	66	0,177
	Based on Median and with adjusted df	1.860	1	65.126	0,177
	Based on trimmed mean	1.871	1	66	0,176

The t-test was conducted to analyze the partial regression coefficients of each variable, with the aim of determining whether the independent variables (X1 and X2) have a distinct effect on the dependent variable (Y). The interpretation criteria for the t-test results are as follows:

1. If the calculated t-value exceeds the critical t-table value or the significance value (Sig.) is less than 0.05, it indicates that the Problem-Based Learning (PBL) model combined with an open-ended approach has a significant impact on the thinking skills of Grade X students at Cahaya Medan Private High School.
2. If the calculated t-value is smaller than the critical t-table value or the Sig. value is greater than 0.05, it suggests that the teaching method does not significantly influence students' thinking abilities. The detailed t-test results are presented in Table 6.

Tabel 6. Results of the t-Test

	2	Significance		Mean Difference	Std. Error Difference
		One-Sided p	Two-Sided p		
1	Equal variances assumed	0,002	0,004	7,853	2,631
	Equal variances not assumed	0,002	0,004	7,853	2,631

Table 6 presents the significant impact of the Problem-Based Learning (PBL) model combined with an open-ended approach on the creative thinking skills of Grade X students at Cahaya Medan Private High School. This finding is supported by significance values of 0.002 and 0.004, along with a t-value of 7.853. Consequently, the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted, as the significance values are below 0.05 and the t-value (7.853) surpasses the critical t-table value (2.631). The findings support the research by Buhaerah and Nasir (2023), which highlights the effectiveness of the open-ended approach in enhancing students' mathematical creative thinking skills. The t-test analysis revealed a significant difference in the development of creative thinking skills between students who were taught using the open-ended approach and those taught using traditional methods. The experimental group, which employed the open-ended approach, showed a greater average improvement, with a significance value of 0.027, which is below 0.05. This further validates the positive impact of this teaching method on the enhancement of students' creative thinking skills. The students in the experimental group, who were taught using the Problem-Based Learning (PBL) model combined with an open-ended approach, demonstrated significant enthusiasm throughout the learning activities, particularly during group discussions. Active engagement was observed as they asked questions, explored various solutions, and showed a strong commitment to understanding and solving the problems presented in the student worksheets (LKPD). This behavior aligns with Ulfa and Asriana's (2018) perspective, which suggests that enthusiasm serves as an indicator of students' intrinsic motivation, prompting them to achieve optimal results and participate in the learning process with interest and independence, without external pressure.

The Problem-Based Learning (PBL) model, when combined with an open-ended approach, facilitates students' engagement in solving problems that provide multiple solutions and strategies. This variety enables students to explore different methods of problem-solving, allowing them to move beyond the limitation of seeking a single correct answer. Students are encouraged to develop their own strategies, which strengthens their understanding of core concepts. The availability of various solutions promotes adaptive thinking, enhances creativity, and stimulates innovative ideas. Furthermore, students learn to approach problems from different perspectives, apply prior knowledge, and experiment with new strategies. This approach is consistent with Savery's (2006) perspective, which stresses the importance of fostering creative thinking to enable students to generate original and inventive solutions to problems. Discussions that examine multiple valid solutions enhance students' collaboration skills by offering opportunities to exchange ideas and strategies with their peers. Valuable insights are gained through the sharing of experiences, both from individual and classmates' perspectives. This collaboration broadens and deepens their understanding of the subject. Consequently, students' creative thinking abilities are further developed, equipping them to effectively address future challenges. The control group, which was taught using traditional methods, did not incorporate an open-ended approach. In this framework, the teacher served as the primary knowledge source, and students followed predefined steps, limiting their ability to explore independently. Consequently, fewer opportunities were provided for these students to engage in activities designed to foster creative thinking. Problems that offered multiple solutions or encouraged diverse strategies were rarely encountered, hindering their ability to approach tasks requiring creative mathematical reasoning. The lack of opportunities to think beyond standard procedures restricted their development of alternative solutions or innovative problem-solving approaches.

CONCLUSION

The study indicates that the integration of the Problem-Based Learning (PBL) model with an open-ended approach leads to a significant improvement in students' mathematical creative thinking skills. The analysis reveals that students exposed to this method achieved higher post-test scores compared to those taught using traditional methods. Statistical analysis through a t-test confirmed that the combination of the PBL model with the open-ended approach substantially enhances students' creative thinking abilities. This instructional strategy is strongly recommended for mathematics education to foster and enhance students' problem-solving creativity.

BIBLIOGRAPHY

Arends,R.I. (2013). Belajar untuk Mengajar (Learning to Teach) 2, E9. Jakarta: Salemba Humanika

Azmi, N., & Yunita, R. (2022). Analisis Kesulitan Siswa dalam Menyelesaikan Masalah Fungsi Kuadrat Di Kelas X MAN 6 Aceh Utara. *Jurnal Pendidikan Matematika*, *3*(1), 41-49.

Badariyah, A, N. (2019). Pengembangan Perangkat Pembelajaran Berbasis Masalah (Problem Based Learning) pada Materi Matriks untuk Kelas X SMK Samarinda. Jurnal PRIMATIKA, 8(1), 33-42.

Buhaerah, & Nasir, M. (2023). Student Representation of Mathematical Thinking in Mathematical Problem-Solving. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *7*(1), 57 -68.

Fajarwati, D., & Ninawati, M. (2023). Effect Size Model Open Ended Learning on Creative Thinking Ability of Elementary School Students. *Jurnal Paedagogy: Jurnal Penelitian dan Pengembangan Pendidikan*, *10*(1), 217-223.

Hartini, T, I., Kusdiwelirawan, A., dan Fitriana, I. (2014). Pengaruh Berpikir Kreatif dengan Model Problem Based Learning (PBL) terhadap Prestasi Belajar Fisika Siswa dengan Menggunakan Tes Open Ended. *Jurnal Pendidikan IPA Indonesia*, 3(1), 8-11.

Hidayah, N. (2022). Pandangan Terhadap Problematika Rendahnya Mutu Pendidikan di Indonesia. *Jurnal Pendidikan dan Konseling*, *4*(4), 6593-6601.

Jayanti, I., & Julianingsih, D. (2021). Kemampuan Berpikir Kreatif Siswa dalam Menyelesaikan Soal *Open-Ended* Ditinjau dari Kemampuan Matematika. *UPIKA: JURNAL PENDIDIKAN MATEMATIKA*, *4*(2), 121-131.

Kadir, I. A., Machmud, T., Usman, K., & Katili, N. (2022). Analisis Kemampuan Berpikir Kreatif Matematis Siswa Pada Materi Segitiga. *Jambura Journal of Mathematics Education*, *3*(2), 128– 138. https://doi.org/10.34312/jmathedu.v3i2.16388

Kartikasari, I. A., Usodo, B., & Riyadi. (2022). The Effectiveness Open-Ended learning and Creative Problem Solving Models to Teach Creative Thinking Skills. *Pegem Journal of Education and Instruction,*, *12*(4), 29-38.

Mahrunnisya, D. (2023). Keterampilan Pembelajar Di Abad Ke-21. *JUPENJI: Jurnal Pendidikan Jompa Indonesia*, *2*(1), 101-109.

Mardhiyah, R. H., Aldriani, S. N. F., Chitta, F., & Zulfikar, M. R. (2021). Pentingnya Keterampilan Belajar di Abad 21 sebagai Tuntutan dalam Pengembangan Sumber Daya Manusia. *Lectura: Jurnal Pendidikan*, *12*(1), 29-40. https://journal.unilak.ac.id/index.php/lectura/article/view/5813/2659

Mussafah, M., & Aprinastuti, C. (2023). Penerapan Model Pembelajaran *Problem Based Learning* untuk Meningkatkan Hasil Belajar Matematika Kelas 2 SD Kanisius Kadirojo. *ELEMENTARY : Jurnal Inovasi Pendidikan Dasar*, *3*(3), 98-104.

Pamungkas, O. Y., & Sudigdo, A. (2022). Profile of Pancasila Students: Implementation of Diversity in MBKM Student's Stories in UST Yogyakarta. *Daengku: Journal of Humanities and Social Sciences Innovation*, *2*(2), 156-164.

Primadoni, A. B., & Muslim, R. I. (2023). Faktor Rendahnya Berpikir Kreatif dalam Menciptakan Inovasi Baru. Jurnal Ilmiah Pendidikan Dasar, 8(3), 958-966.

Purba, M.C., & Harahap, N.A. (2021). Kemampuan Berpikir Kreatif Matematis Menggunakan Model Pembelajaran Cooperative Script Berbantuan Aplikasi Geogebra di SMA Negeri 1 Rantau Utara. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(2), 2115-2122.

Rasnawati, A., Rahmawati, W., Akbar, P., & Putra, H. D. (2019). Smk Pada Materi Sistem Persamaan Linier Dua Variabel. Jurnal Cendikia: Jurnal Pendidikan Matematika, 3(1), 164-177.

Saidah,I., Dwijanto, & Iwan,J. (2020). Kemampuan Berpikir Kreatif Siswa dalam Pembelajaran Matematika. *Prosiding Seminar Nasional Pascasarjana Universitas Negeri Semarang.*1042-1045

Santi, I., Maimunah, & Roza, Y. (2019). Analisis Kemampuan Berpikir Kreatif Matematis Siswa SMK pada Materi Barisan dan Deret di Kota Pekanbaru. *Jurnal Derivat*, *6*(2), 95-106.

Sari, L.M., & Hrp, N.A. (2022). Peningkatan Kemampuan Berpikir Kreatif Matematis Siswa Menggunakan Metode Quantum Teaching pada Kelas VIII SMP N 1 Merbau.*Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(2), 1741-1750

Satria, R., Adiprima, P., Wulan, K. S., & Harjatanaya, T. Y. (2022). *Panduan Pengembangan Projek Penguatan Profil Pelajar Pancasila*. Badan Standar Kurikulum dan Asesmen Pendidikan, Kemdikbudristek.

Savery, J, R. (2006). Overview of Problem-Based Learning: Definitions and Distinctions. *Interdisciplinary journal of Problem-Based Learning* 1(1), 5. Tersedia di https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1002&context=ijpb

Sholikah, K., Febriyanti, R., Ilmayasinta, N. (2023). Pengaruh Model Problem Based Learning terhadap Peningkatan Kemampuan Pemecahan Masalah Matematika. *Jurnal Pendidkan Matematika Primatika*, 12(2), 79-88.

Situmorang, A. S. (2022). Pengaruh Pendekatan *Open-ended* terhadap Kemampuan Berpikir Kreatif Matematis Peserta Didik. *SEPREN: Journal of Mathematics Education and Applied*, *4*(1), 74-80. https://doi.org/10.36655/sepren.v4i1

Sulistiyarini,, A., Sukarno, & Triyanto. (2020). he impact of reading activity before lesson on creative thinking skill. *3rd International Conference on Learning Innovation and Quality Education (ICLIQE 2019) The*, *397*, 593–601. https://doi.org/10.2991/assehr.k.200129.074

Suryaningsih, T., & Astuti, M. A. (2021). Pengaruh Model Pembelajaran *Open Ended* terhadap Kemampuan Berpikir Kreatif Matematis Siswa Kelas IV pada Materi Pecahan. *Elementar : Jurnal Pendidikan Dasar*, *1*(1), 95-104. https://doi.org/10.15408/elementar.v1i1.20892

Sya'Roni, A. R., Inawati, P. A., Guswanto, E., Susanto, & Hobri. (2020). Students' creative thinking skill in the flipped classroom-blended learning of mathematics based on lesson study for learning community. *Journal of Physics: Conference Series*, *1563*(1).

Torrance, E. P. (1990). *Test of Creative Thinking*. Beaconville: Scholatic Testing Service

Ulfa, F, M., & Asriana, M. (2018). Keefektifan Model PBL dengan Pendekatan Open-ended pada Pencapaian Kemampuan Berpikir Kreatif Matematis dan Disposisi Matematis Siswa *Prisma, Prosiding Seminar Nasional Matematika*, Universitas Negeri Semarang. 289-298.

Utami, R. W., Endaryono, B. T., & Djuhartono, T. (2020). Meningkatkan Kemampuan Berpikir Kreatif Matematis Siswa Melalui Pendekatan *Open-Ended*. *Faktor Jurnal Ilmiah Kependidikan*, *7*(1), 43-48.

Wardani, Y. E., & Suripah. (2023). Kemampuan Berpikir Kreatif Matematis Siswa SMA Berdasarkan Kemampuan Akademik. Jurnal Cendekia: Jurnal Pendidikan Matematika, 7(3), 3039-3052

Wijayanti, A., Zuhri, M. S., & Muhtarom, M. (2019). Profil Kemampuan Berpikir Kreatif dalam Memecahkan Masalah Tipe *Open Ended* pada Siswa Kelas VIII Ditinjau dari Kemampuan Matematis Tingkat Tinggi dan Rendah. *SENATIK*, 340–345.

Zakaria. (2021). Kecakapan Abad 21 dalam Pembelajaran Pendidikan Dasar Masa Pandemi Covid-19. *Dirasah*, *4*(2), 81-90.